89942

S/126/61/011/001/009/019
E111/E452

Change in Structure and Phase Composition of Some Austenitic Steels in the Initial Stages of Cavitation Failure

Specimens were plunged in water after holding for 30 minutes at 1050°C. After removal of the outer layers, specimens were subjected to the cavitation action of a magnetostriction vibrator for 5, 10, 15 and more minutes. Phase composition changes were qualitatively determined from X-ray patterns obtained from a polished section. Structural changes were determined from interference-line width and also changes in shape and dimensions of individual spots. The back-reflection camera provided three images of the same interference ring on one film at different specimen-film distances. Spot dimensions were measured on all rings in tangential and radial directions with the aid of a type ИЗА-2 (IZA-2) comparator. Patterns were obtained from the same part of a given specimen after various treatments. Line width was measured on patterns obtained separately in chromium radiation with rotation of both specimen and film. Two of the steels were also studied electron-microscopically before and after testing for 5 and 10 minutes. The work showed that the austenite lines obtained exclusively from all specimens before testing were

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Change in Structure and Phase Composition of Some Austenitic Steels in the Initial Stages of Cavitation Failure

supplemented in three of the steels by other lines after testing. The transformation of austenite was different in two steels: in type 1Х18Н8 (1Kh18N8) the alpha-phase was formed; in type 30Г10Х9 (30G10Kh9) epsilon-phase was formed as well. This was confirmed in the electron photomicrographs. In type 40Н25 (40N25) steel the transformation was similar to that in 1Kh18N8 but slower, while in 80Г14 (80G14) only austenite lines were found even after prolonged specimen treatment. Interference spots generally survived specimen treatment and spot changes were similar in all four steels. The situation is qualitatively represented by the authors in terms of changes in the disorientation angle for individual crystals. In Fig.5, this angle (minutes) is plotted against treatment time (minutes) for various crystals of 40N25 (plot "a") and 80G14 (plot "b") steels. For all the steels the width of the $(311)_\beta$ line increased in the first stages of treatment and then became steady. From the photometric curve of the $(311)_\beta$ line dimensions of mosaic blocks and II type disturbances were found (as in Ref.2): in the first

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Change in Structure and Phase Composition of Some Austenitic Steels in the Initial Stages of Cavitation Failure

few minutes the former decrease rapidly and the latter increase; the intensity of these effects being different for the different steels. The authors conclude that resistance to cavitation disruption rises when tetragonal martensite, epsilon phase and fine carbides are liberated within the austenite grain; resistance falls when alpha-phase (low in carbon) is liberated either within or around the grain. There are 7 figures, 2 tables and 3 Soviet references.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: April 4, 1960

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21362

18.1285 1454, 1555, 2808

S/126/61/011/004/009/023
E021/E435

AUTHORS: Bogachev, I.N., Mints, R.I., Petukhova, T.M. and D'yakova, M.A.

TITLE: The Influence of Phase Composition and Structure on the Cavitation Stability of Titanium and its Alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.4, pp.557-563

TEXT: Testing was carried out on an erosion stand with a circumferential speed of rotation of the samples of 78 m/sec, a constant pressure of water 0.28 atm, diameter of jet 8 mm and distance 1.8 cm. The cavitation stability was evaluated by the loss in weight every 5 hours of testing. Alloys with α-phase structure (commercial Ti type ВТ1Д (VT1D), Ti-3.5 Al, Ti-2.5 Al-5Sn, Ti-6Al-4V) showed slip lines and twins in the initial stages. With increase in time, cracks developed along the twins, the slip lines and along the grain boundaries. Table 1 shows the influence of alloying on the stability of α alloys. Solid solutions of the β phase (Ti - 3.25 Al - 10.45 Cr - 7.95 Mo - 0.11 Fe and Ti - 9.6 V - 2.84 Al - 3.8 Mn) showed some disintegration simultaneously in the grain boundaries and in the grains (Fig.2).

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Although the β solid solutions were more resistant to cavitation than the α, they were liable to sudden fracture and were unsuitable for use in such conditions. Alloys with a martensitic structure were also tested. The martensitic structure was produced by fast cooling from the β region. During testing the α'-phase was destroyed more uniformly than the α phase. Disintegration began at the grain boundaries and in the grains at the boundaries of the martensitic needles. Fig.1 shows the initial stages of cavitation of the α and α'-phases. The martensitic structure has a high resistance to cavitation as shown by Fig.3, where the loss in weight (mg) is plotted against the time of testing (hours) for the α, α', α + α' and α + β phases of the same alloy. The presence of a fine acicular martensitic structure leads to increase in the cavitation stability. The resistance to cavitation of an alloy consisting of α + β was intermediate between the resistance of α and α'. Disintegration began at the boundaries of the two phases and developed in the phase which was less stable towards cavitation. A mixture of β and ω phases was obtained by heat treatment of the Ti - 9.6 V - 2.84 Al - 3.8 Mn alloy. The formation of the ω phase

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led to an increase in hardness from 360 to 495 kg/mm2. Cavitation caused a network of slip lines as in the case of the β phase. The resistance to cavitation of the β + ω alloy was higher than that of the β alloy, but it was liable to sudden fracture as was the β alloy. Thus the cavitation stability of titanium alloys depends on the structure and phase composition and not on the mechanical properties. There are 4 figures, 2 tables and 2 references: 1 Soviet and 1 non-Soviet.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: July 30, 1960

X

31055
S/126/61/012/004/015/021
E193/E383

18.1285

AUTHORS: Bogachev, I.N. and D'yakova, M.A.

TITLE: The kinetics of decomposition of β-solid solution in a heavily-alloyed titanium alloy

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 4, 1961, 607 - 612

TEXT: It has been shown by other workers (e.g. Ref. 1 - E.L. Harmon, J. Kozol and A.R. Troiano, Trans. ASM, 1958, 50, 418) that, in the presence of elements stabilizing the β-Ti phase, decomposition of this phase in solid Ti-base solutions can be accompanied by the formation of a hexagonal ω-phase (a = 4.6 kX, c = 2.82 kX), orientated relative to the β-phase in such a way that $a_\omega \parallel [110]_\beta$ and $c_\omega \parallel [111]_\beta$.
The object of the present investigation was to study the kinetics of decomposition of the β-phase in a Ti-base alloy, containing 9.65% V, 3.84% Mn and 2.57% Al, by hardness, electrical resistance and dilatometric measurements. In the first series of experiments, the specimens were heated in

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S/126/61/012/004/015/021
The kinetics of decomposition E193/E383

vacuum for one hour at 900 °C, quenched in a molten nitrate bath at various temperatures, held at a given temperature for various times and then cooled to room temperature, after which the relative change in length, $\Delta\ell/\ell$, of the specimens was determined. The results are reproduced in Fig. 1, where $\Delta\ell/\ell \times 10^{-4}$ is plotted against time (hrs) at the temperature (°C) indicated by each curve. It will be seen that isothermal treatment at temperatures between 160 and 380 °C brought about contraction of the alloy, which indicated the formation of the ω-phase. The results of hardness measurements of similarly-treated specimens are reproduced in Fig. 4, where Vickers hardness is plotted against the isothermal-treatment temperature, the time at temperature being indicated by each curve. In Fig. 5, the electrical resistivity (ρ, Ω mm^2/m) of the alloy is plotted against the temperature (°C) of isothermal treatment of 30 min (crosses), 3 hours (triangles) and 6 hours (circles) duration. Dilatometric heating and cooling curves were also constructed and metallographic examination of some specimens was carried out. Based on the results obtained, a diagram of

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E193/E383

The kinetics of decomposition ....

the isothermal transformation (TTT curves) of the β-phase in the alloys studied was constructed. It is reproduced in Fig. 3, showing the constitution of the alloy as a function of temperature (vertical axis, °C) and time (horizontal axis, sec); the experimental points denoted by circles are based on metallographic examination; the dilatometric data are represented by x - x and x -- x lines indicating, respectively, the beginning and end of volume expansion, and by dots indicating the beginning and end of the volume contraction. The results of the present investigation indicate that there are two distinct modes of decomposition of the β-phase in the alloys studied. Decomposition at temperatures above 500 °C entails the formation of the α-phase. In the 160 - 370 °C range, the ω-phase is formed which brings about a considerable increase in hardness and causes embrittlement of the alloy. Between 380 and 480 °C the formation of the α-phase is proceded by the formation of the ω-phase, the latter also being accompanied by an increase in hardness. It was also found that the β → ω transformation was reversible. Specimens, hardened by quenching from 900 °C and isothermal treatment at

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S/126/61/012/004/015/021
E193/E383

The kinetics of decomposition ....

300 °C, can be fully restored to their soft condition by 30 sec holding at 500 °C, followed by water-quenching. Partial restoration only can be attained in the case of material isothermally treated at 350 or 370 °C or when the duration of the treatment is excessively long.
There are 5 figures, 1 table and 5 references: 2 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M. Kirova (Ural Polytechnical Institute im. S.M. Kirov)

SUBMITTED: March 21, 1961

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S/126/61/012/005/007/028
E025/E435

AUTHORS: Bogachev, I.N., Mel'nikova, V.I.

TITLE: Kinetics of ordering in the alloy Ni_3Mn

PERIODICAL: Fizika metallov i metallovedeniy, v.12, no.5, 1961, 678-684

TEXT: The ordering kinetics of the phase Ni_3Mn are studied by measuring the changes in electrical resistivity, saturation magnetization and coercive force during the isothermal annealing of the completely disordered alloy at temperatures below the critical ordering temperature T_c. It is shown that in each case the changes take place in two stages. Resistivity initially increases slightly then decreases rapidly; the saturation magnetization first increases rapidly with subsequent fall-off of the rate of increase; the coercive force rises sharply after an initial static period. In all three cases, the rate of ordering is greatest for the specimens in the range 450 to 475°C, some 60°C below T_c. The two stages of ordering are discussed in terms of the initial growth of nuclei as antiphase domains, and the subsequent growth and coagulation of these domains. It is suggested that in the temperature range 450 to 475°C, conditions

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are the most favourable for nucleation of the ordered phase and thus the approach to the fully ordered state occurs at the greatest rate. There are 6 figures and 17 references: 3 Soviet-bloc and 14 non-Soviet-bloc. The four most recent references to English language publications read as follows:

Ref.13: Burns F.P., Quimby S.L. Phys. Rev., v.97, 1955, 6;
Ref.14: Lord N.W. J. Chem. Phys., v.21, 1953, 692;
Ref.15: Feder R., Moony M., Nowick A.S. Acta met., v.6, no.4, 1958;
Ref.16: O'Brien J.L., Kuczynski G.C. Acta met., v.7, no.12, 1959, 803.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova
(Ural Polytechnical Institute im. S. Kirov)

SUBMITTED: March 6, 1961

S/126/61/012/005/006/028
E025/E435

AUTHORS: Yershova, L.S., Bogachev, I.N., Shklyar, R.S.

TITLE: The effect of deformation on the formation of ε-phase in manganese steels

PERIODICAL: Fizika metallov i metallovedeniy, v.12, no.5, 1961, 670-677 + 1 plate

TEXT: The kinetics of formation of ε-phase and the effects of plastic deformation of the $\gamma \Rightarrow \varepsilon$ transformation are studied in a series of C-Mn-Ni steels. In a 20% Mn steel the $\gamma \Rightarrow \varepsilon$ transformation is found to take place at a 100°C for steel with a C content below 0.1%; however, if the C content is increased to 0.3% the transformation temperature falls to below zero. Under plastic deformation far greater strain hardening is exhibited by the low-C steel due to the larger capacity for strain hardening of the ε-phase. The behaviour is compared with a 26% Ni steel, where the austenite breaks down to ferrite under plastic deformation and with an 18% Ni, 6% Mn steel where the austenite does not undergo a transformation during deformation. Further studies on the Mn steels show that the character of the phase transformation on plastic deformation depends on the

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The effect of deformation ... S/126/61/012/005/006/028
E025/E435

relative values of the deformation temperature and the critical temperatures of $\gamma \rightarrow \alpha$ and $\gamma \rightarrow \varepsilon$ transformations.
D.S.Steynberg is mentioned in the article in connection with his testing apparatus. There are 7 figures, 2 tables and 4 references: 1 Soviet-bloc and 3 non-Soviet-bloc. The three references to English language publications read as follows:
Ref.1: Walters F.M., Welles C. Trans. ASM, v.24, no.2, 1936, 359;
Ref.3: Troiano A.R., McGuire F.T. Trans. ASM, v.31, 1943, 340;
Ref.4: Cina B. Acta met, v.6, no.12, 1958.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova (Ural Polytechnical Institute im. S. Kirov)

SUBMITTED: February 27, 1961

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BOGACHEV, I.N.; MEL'NIKOVA, V.I.

Kinetics of ordering in Ni_3Mn alloys. Fiz. met. i metalloved. 12 no.5:678-684 N '61. (MIRA 14:12)

1. Ural'skiy politekhnicheskiy institut imeni S.M. Kirova.
(Nickel-manganese alloys—Metallography)
(Metal crystals)

BOGACHEV, Ivan Nikolayevich; SYRCHINA, M.M., red. izd-va; MAL'KOVA, N.T., tekhn. red.

[Metallography of cast iron]Metallografiia chuguna. 2. izd. dop. i ispr. Sverdlovsk, Metallurgizdat, 1962. 392 p. (MIRA 15:12)

(Cast iron—Metallography)

32546
S/128/62/000/001/002/002
A004/A127

18.8360

AUTHORS: Bogachev, I.N.; Mints, R.I.

TITLE: Cavitation resistance of cast austenitic steels

PERIODICAL: Liteynoye proizvodstvo, no. 1, 1962, 30 - 32

TEXT: The authors report on tests carried out to study the cavitation resistance of various steel grades. The tests were carried out on an impact-erosion stand. The specimen rotation speed was 78 m/sec, the constant water pressure being 0.28 atm. The nozzle outlet bore was 8 mm in diameter, while distance d = 1.4 cm. The authors point out that corrosion resistance is only one pre-requisite of parts operating under cavitation effect. To ensure a high cavitation resistance, the steel should possess a high resistance to micro-impact action, its structure should represent a homogeneous solid solution. Ferrite possesses the lowest cavitation resistance, while martensite is most cavitation-resistant. Based on the tests, the 30Х10Г10 (30Kh10G10) non-nickel austenitic steel has been developed. Steels of this type were investigated having the following composition: 0.28 - 0.44% C; 7 - 10.6% Mn; 9.6 - 12% Cr; 0.34 -0.57% Si; 0.011 - 0.041% S; and 0.01 - 0.032% P. The authors show the effect

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32546
S/128/62/000/001/002/002
A004/A127

Cavitation resistance of cast austenitic steels

of the austenitic nature of the steel on the cavitation resistance by an example and point out that the 30Kh10G10 grade steel ensures a more intensive hardening of the surface layer than the 1X18H8 (1Kh18N8) grade steel. It is stated that, generally, the less stable chrome-manganese austenite has a higher cavitation resistance, since it is subjected to self-hardening during the cavitation process owing to the austenite decomposition and the formation of martensite and the ε-phase. The test results show that, in choosing cavitation-resistant steels, preference should be given to stainless, austenitic alloys with an unstable structure, which are hardened not only by the plastic deformation of the initial structure, but by phase transformation. Tables show the mechanical properties of such steels after austempering heat treatment, depending on the deformation temperature and the effect of the deformation rate on the mechanical properties of steel with 0.28% C, 8.8% Mn and 10.9% Cr. The higher the heating temperature and the time of isothermic holding, the greater is the formation of the α-phase and carbides. A table shows the cavitation resistance of 30Kh10G10 grade steel in comparison with other grades mainly used in the construction of hydraulic machines. There are 4 figures, 7 tables and 8 references.

X

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S/114/62/000/004/005/008
E114/E554

18.1150

AUTHORS: Bogachev, I.N., Doctor of Technical Sciences, Professor and Mints, R.I., Candidate of Technical Sciences

TITLE: Principles underlying the choice of steel for hydraulic turbines

PERIODICAL: Energomashinostroyeniye, no.4, 1962, 27-30

TEXT: Certain steels with good anti-corrosive properties, such as 18-8 chrome-nickel stainless steel are, nevertheless, easily damaged by cavitation. The article relates the results of microscopic investigations of the relationship between the structure of metal and its resistance to cavitation, which lead to the conclusion that in addition to having good anti-corrosive properties, the suitable steel should withstand well the micro-impulsive forces. Therefore such steel will be a homogeneous solid solution. The least resistance to cavitation is offered by ferritic steels and the great by martensite. The most suitable steels are austenitic, which, in the process of deformation, have the property of self-hardening by the conversion of

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some of the austenitic structures into martensite. For example, the unstable austenitic steel containing at least 0.3-0.4% carbon forms martensite along the lines of deformation when subjected to micro-impulsive forces and is, therefore, well resistant to cavitation. It is necessary to choose the ratio between the carbon content and the content of the alloying elements in the austenitic steel such that martensite should not begin to form too early. Based on the foregoing, a new austenitic steel designated 30Х10Г10 (30Kh10G10) was developed containing about 0.3% carbon, and equal quantities of chrome and manganese. This steel is less stable than 18-8 chrome-nickel steel and it therefore has greater self-hardening properties. Instead of wearing by pitting and by growth of individual pits, the new steel wears uniformly over the whole surface. To withstand cavitation, the steel should not only deform plastically under cavitation, but also the super-saturated solid solution of austenite should decompose with the formation of martensite. The exact chemical analysis of the 30Kh10G10 steel is 0.28-0.32% C, 9-10% Cr, 9-10% Mn, 0.3-0.5% Si, 0.02-0.03% P, 0.03-0.04% S.

Principles underlying the ... S/114/62/000/004/005/008
E114/E554

After quenching in water or air from 1100°C, the steel assumed austenitic structure. Mechanical properties are given and resistance to cavitation is shown in tabular form to compare well with other steels. The new steel can be used in the form of castings, sheet and welding material. There are 5 figures and 3 tables.

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BOGACHEV, I.N., doktor tekhn.nauk, prof.; MINTS, R.I., kand.tekhn.nauk; PETUKHOVA, T.M., inzh.

Effect of phase constitution on the cavitation resistance of bronze. Metalloved.i term.obr.met. no.4:28-31 Ap '62. (MIRA 15:4)

1. Ural'skiy politekhnicheskiy institut.
(Bronze—Metallography) (Phase rule and equilibrium) (Cavitation)

35948
S/126/62/013/001/009/018
E111/E580

18.7500

AUTHORS: Yershova, L.S. and Bogachev, I.N.

TITLE: Influence of preliminary plastic deformation on the $\gamma \rightarrow \varepsilon$ transformation in manganese steel

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.1, 1962, 107-113

TEXT: It is known that preliminary plastic deformation greatly affects the martensite transformation, but there are no published data on the influence of preliminary plastic deformation on the transformation of austenite into the ε-phase. In the present work, type Г20 (G20) steel (0.06% C and 19.7% Mn) was used. In this alloy, transformation of austenite into ε-phase on cooling starts at 90-100°C and continues down to room temperature. Deformation (up to 33.2% at 300 and up to 27.3% at 450°C) was carried out by extension of tensile test specimens machined from water-quenched samples, followed by metallographic and dilatometric testing, hardness measurement and X-ray phase analysis. All specimens were air cooled after deformation. From their deformed zones, 5-10 mm thick specimens were prepared and

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annealed in a lead bath at 400, 650 and 850°C. The work showed that preliminary plastic deformation has a regular and substantial effect on the transformation of austenite into the ε-phase. Up to 3% deformation at 300°C has a strong activating effect on the transformation, but heavier deformation produces a stabilizing influence which becomes more pronounced with increasing deformation. The activating effect is attributed to stresses produced at small deformations, the stabilizing effect to the refinement of grains and mosaic blocks and the formation of shear planes. Preliminary deformation at 450°C has only the stabilizing effect, as a result of improvement in the plastic properties of the alloy. Annealing of an alloy previously deformed at 300-400°C increases stabilization because stresses are removed and further block boundaries produced. The ε-phase, formed by cooling both previously deformed and undeformed austenite leads eventually to further strengthening of the alloy. The dispersion of the ε-phase formed on cooling deformed austenite is greater than that of ε-phase formed from undeformed austenite. The phase transformation of austenite into ε-phase has features characteristic of the

Influence of preliminary ... S/126/62/013/001/009/018
E111/E580

martensite mechanism. There are 5 figures.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im.S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: May 12, 1961

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36679

S/126/62/013/002/009/019
E021/E480

18.1150

AUTHORS: Bogachev, I.N., Mel'nikova, V.I.

TITLE: The influence of plastic deformation on the process of ordering in nickel-manganese alloy

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.2, 1962, 248-257

TEXT: The two alloys investigated contained: Alloy 1: 23.54% Mn, 0.63% Fe, 0.07% C, 0.21% Si, 0.005% P and 0.027% S; Alloy 2: 23.30% Mn, 0.68% Fe, 0.02% C, 0.24% Si, 0.007% P and 0.017% S. Wire samples prepared from Alloy 1 were quenched in water from 1000°C. Various stages of ordering were obtained by holding for different times at 450°C and quenching in water. The samples were then deformed by drawing at room temperature. The change in electrical resistance in the process of plastic deformation was followed. Electrical resistance and mechanical properties were measured on cold-drawn Alloy 2 wire with 89% deformation. Magnetic measurements were carried out on cylindrical specimens (3 mm diameter, 50 mm length) with 88% reduction. After heating at 350, 400, 425, 450, 475 and

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500°C, the samples were water-quenched and measurements were carried out at room temperature. Results showed that plastic deformation of samples in the quenched state or in the initial stages of ordering decreased the electrical resistance but increased it in the later stages of ordering. The difference in effects is attributed to the different structural states. Electrical resistance, magnetic properties and tensile strength of deformed nickel-manganese alloys changes in two stages during ordering. In the first stage the change is probably caused by the occurrence of a large number of ordered regions of small dimensions. The second stage is connected with the increase in size of the ordered domains and an increase in quantity of ordered material. The maximum rate of the ordering process is observed in the range 450 to 475°C. Near the temperature of phase transformation the rate of ordering is slow as a result of the small difference between the free energy of ordered and disordered phases. The decrease in ordering rate at temperatures below 450°C is probably connected with a decrease in the mobility of atoms. There are 5 figures and 1 table.

S/126/62/013/002/009/019
The influence of plastic deformation .. E021/E480

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: March 6, 1961

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X

KOLEVATOV, V.N.; BOGACHEV, I.N.

Effect of the shape and size of graphite on gray cast iron plasticity. Fiz. met. i metalloved. 13 no.2:258-262 F '62. (MIRA 15:3)

1. Institut metallurgii Ural'skogo filiala AN SSSR i Ural'skiy politekhnicheskiy institut im. S.M.Kirova.
(Cast iron--Metallography) (Plasticity)

36685

S/126/62/013/002/015/019
E111/E135

18.7500

AUTHORS: Yershova, L.S., and Bogachev, I.N.

TITLE: Study of phase work hardening during the $\gamma \rightleftarrows \varepsilon$ transformation in an iron-manganese alloy

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.2, 1962, 300-304

TEXT: The influence of phase transitions on the rate of the $\gamma \rightleftarrows \varepsilon$ transformation was studied. This study was carried out since the authors found no published work on this subject. Type Г20 (G20) alloy (0.06% C, 19.7 Mn, 0.92 Si, 0.003S and 0.009 P) was used. Dilatometric specimens and specimens for metallographic and X-ray structural analysis were prepared from the heat-treated material. Both fine and coarse-grained specimens were used. Phase transitions were effected by heating for 3-5 minutes in a salt bath and cooling in air, X-ray and metallographic examination and hardness tests being made after each cycle. Dilatometric investigation was carried out with repeated heating to 300 °C-air cooling cycles. The influence of

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annealing on the structure of the alloy previously subjected to phase work-hardening was also studied for lead-bath annealing at 370, 620 and 800 °C. In its initial hardened state the alloy contains about 50% ε-phase, which changes into austenite at 150-200 °C, the reverse starting at 90-100 °C. The work showed that repeated $\gamma \rightarrow \varepsilon$ and $\varepsilon \rightarrow \gamma$ transitions affect the transformation considerably, not more than 4 cycles activating it and producing some hardening, while more heating-cooling cycles have the opposite effect. Phase transitions affect the $\gamma \rightarrow \varepsilon$ transformation in a manner similar to preliminary plastic deformation in the austenitic state. The activating effect of a few phase transitions is due primarily to the residual stresses produced in the austenite during forward and reverse phase transformations. The stabilizing effect with a large number of transitions is due mainly to mosaic-block breakdown processes. Annealing at 350-400 °C of specimens previously subjected to a number of heating and cooling cycles eliminates the activating effect of the few-cycles treatment and leads to additional stabilization of austenite. Austenite grain shape and size are maintained during repeated cycles, this being the manifestation of the heredity of the austenite grain. With the aid of phase work-hardening followed by recrystallization, austenite in manganese alloys containing a considerable quantity of ε-phase can be recrystallized. The martensitic character of the ε-transformation is confirmed by the formation of a relief on a polished surface, as a result of the phase transformation. There are 6 figures.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M. Kirova
(Ural Polytechnical Institute imeni S.M. Kirov)

SUBMITTED: June 30, 1961.

X

36593
S/126/62/013/003/010/023
E111/E435

18.1100

AUTHORS: Mints, R.I., Bogachev, I.N.

TITLE: Hardening of solid solutions based on iron during local loading

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.3, 1962, 399-405

TEXT: It is known that under the given conditions, phase and structural changes greatly affect the resistance of austenitic alloys to concentrated impact and micro impact loading. In the present investigation, hardening during local static and impact loading of austenite, ferrite, martensite and ε-phase was studied. The range of compositions covered, in addition to armco iron, was: 0.03 to 0.38% C, traces to 37.8% Mn, traces to 0.27% Cr, traces to 36.4% Ni, 0.17 to 0.58% Si, 0.01 to 0.17% P, 0.007 to 0.030% S. Local static loading was carried out on a Brinell test machine (sphere diameter 5 mm, load 750 kg). Concentrated impact was delivered by a 6 kg weight sharpened to 60° falling through a height of 0.5 m. Micro impact was obtained by means of a hydraulic micro-erosion test stand

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Hardening of solid solutions ... S/126/62/013/003/010/023
E111/E435

(specimen revolved at a velocity of 78 m/sec, jet pressure 0.28 atm, nozzle diameter 5 mm). After annealing and water quenching (to obtain the required range of phases) the specimens were tested. Hardening was studied by microhardness measurements on metallographic polished sections. It was found that all the solid solutions are only slightly and similarly hardened by local static loading but, under local impact and micro impact loading, show a considerable and different tendency to hardening. The low-carbon austenitic nickel and manganese alloys showed this effect; the differences are due to the nature of the plastic deformation and of the solid solution (i.e. nickel or manganese austenite). The martensite and ε-phase formed in the course of plastic deformation can harden spontaneously which leads to general hardening of the corresponding alloys. The formation of ε-phase as a result of solid-solution decomposition during plastic deformation, brought about by local impact and micro impact loading, produces greater hardening of the alloy than when ε-phase is formed through heat treatment. The hardening of alloys by plastic deformation is due to the plastic deformation of
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the solid solution, phase changes during the decomposition of the solid solution and hardening of the new phase formed as a result of this decomposition. The extent to which each factor contributes to the general ability of the alloy to harden depends on the nature of the solid solution an. loading. There are 8 figures and 1 table.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M.Kirova (Ural Polytechnical Institute imeni S.M.Kirov)

SUBMITTED: March 17, 1961 (initially)
October 25, 1961 (after revision)

APPROVED FOR RELEASE: 06/09/2000 CIA-RDP86-00513R000205730012-1"

KOLEVATOV, V.N.; BOGACHEV, I.N.

Resistance to divorcement as one of the characteristics of the structural strength of cast iron. Fiz. met. i metalloved. 13 no.4:546-549 Ap '62. (MIRA 16:5)

1. Ural'skiy politekhnicheskiy institut imeni S.M.Kirova i Institut metallurgii Ural'skogo filiala Akademii nauk.
(Cast iron--Metallography)

S/126/62/014/006/004/020
E111/E151

AUTHORS: Bogachev, I.N., and Malinov, L.S.

TITLE: Influence of chromium and nickel on the $\gamma \rightleftarrows \varepsilon$ transformation in an iron-manganese alloy

PERIODICAL: Fizika metallov i metallovedeniye, v.14, no.6, 1962, 828-833

TEXT: As this effect has not been adequately studied, the present research was considered to be of interest. An alloy of iron with 20% manganese was used as the standard and also as the base alloy for preparing the chromium- and nickel-alloyed materials: types Г20Х2 (G20Kh2), Г20Х6 (G20Kh6), Г20Х10 (G20Kh10), Г20Н2 (G20N2), Г20Н6 (G20N6), Г20Н10 (G20N10). X-ray, dilatometric, hardness-measurement and metallographic methods were used, the alpha-phase being determined magnetically. Addition of chromium or nickel was found to lower the temperature at which the $\gamma \rightarrow \varepsilon$ transformation commenced, but to have no effect on that of its completion. The commencing temperature of this transformation is a linear function of the alloying-element concentration. Chromium or nickel additions also cause the

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reverse transformation to take place at a lower temperature; the temperature of both its commencement and completion being a linear function of alloying-element concentration. The amount of ε-phase decreases in proportion to the increase in alloying-element concentration, and is somewhat greater in quenched than in annealed specimens. The effect of chromium and nickel on the temperature range of the $\gamma \rightarrow \varepsilon$ transformation and the kinetics of the ε-phase formation on continuous cooling is similar to that on the martensitic transformation in carbon steels. The effect of nickel on the $\gamma \rightleftarrows \varepsilon$ transformation is about 5 times as great as that of chromium.
There are 6 figures and 2 tables.

ASSOCIATION: Ural'skiy politekhnicheskiy institut im. S.M. Kirova
(Ural Polytechnical Institute imeni S.M. Kirov)

SUBMITTED: May 24, 1962

BOGACHEV, I.N.; MAKHANEK, G.V.

Thermokinetics of graphite formation in gray cast iron. Lit. proizv. no.2:18-20 F '63. (MIRA 16:3)
(Cast iron--Metallography) (Crystallization)

BOGACHEV, I.N., doktor tekhn. nauk; MINTS, R.I., kand. tekhn. nauk

Increasing the cavitation resistance of machine parts by the use of surface-active agents. Izv. vys. ucheb. zav.; mashinostr. no.2:224-230 '63. (MIRA 16:8)

1. Ural'skiy politekhnicheskiy institut.

L 17735-63 EWP(k)/EWP(q)/EWT(m)/BDS AFFTC/ASD Pf-4/Pad
JD/HW

ACCESSION NR: AP3006149 S/0148/63/000/007/0162/0168

75
74

AUTHORS: Bogachev, I. N.; Roshkova, S. B.

TITLE: Hardening of austenite steel during cold plastic deformation.

16

SOURCE: IVUZ. Chernaya metallurgiya, no. 7, 1963, 162-168

TOPIC TAGS: steel, austenite steel, steel hardening, cold plastic deformation, C, Si, Mn, P, S, Cr, Ni, Ti, 40G13 steel, 40Kh10G10 steel

ABSTRACT: The effect of cold plastic deformation on the structure and properties of steel of various compositions of C, Si, Mn, P, S, Cr, Ni, and Ti has been studied. After plastic deformation (rolling), the most significant increase in hardness was observed in steels of the type 40G13 and 40Kh10G10. The sharpest increase in hardness was observed when the degree of deformation was increased up to 10%, a further increase of deformation resulted in more uniform change of hardness. Nickel and chrome-nickel austenite steels are hardened to a much lesser degree. The addition of chrome did not exhibit an

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ACCESSION NR: AP3006149

effect upon the hardness of the studied steels. The increase in hardness of the above steels is explained by the fact that these steels are not stable in cold plastic deformation; they undergo a martensite transformation by forming a large quantity of Alpha-phase. The quantity of Alpha-phase increases with an increase of the degree of deformation. With an increase of temperature, the thermodynamic stability of austenite increases. When the deformation temperature of 40G13 steel was increased to 100 and 200C, the quantity of Alpha-phase decreased, thus, decreasing its hardness. However, at 400 and 600C, the hardness did not change. It was concluded that the stability of austenite steels during plastic deformation depends upon the nature of austenite. The unstable manganese and chrome-manganese austenite steels, when heated after a plastic deformation, are softened much faster even at much lower temperatures than the stable chromium-nickel steel. This is also affected by an additional softening which takes place by means of martensite transformation of the austenite, which is formed during plastic deformation. The plastic deformation increases the deformation process sharply of both stable

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L 17735-63

ACCESSION NR: AP3006149

and unstable austenite steels. The hardness of deformed chromium-nicket steel can be additionally increased by means of a short-time aging. Orig. art. has: 7 figures and 1 table.

ASSOCIATION: Ural'skiy politekhnicheskiy institut (Ural politechnic institute)

SUBMITTED: 21Feb61 DATE ACQ: 18Sep63 ENCL: 00

SUB CODE: ML NO REF SOV: 004 OTHER: 000

Card 3/3

BOGACHEV, I.N.; DAVYDOV, G.S.

Effect of the volume of martensite transformation on the graphitization of white cast iron. Izv. vys. ucheb. zav.; chern. met. 6 no.2:104-110 '63. (MIRA 16:3)

1. Ural'skiy politekhnicheskiy institut.
(Cast iron—Metallography)
(Metals, Effect of temperature on)

BOGACHEV, I.N.; ROZHKOVA, S.B.

Role of defects in the acceleration of the graphitizing process after hardening. Izv. vys. ucheb. zav.; chern. met. 6 no.6: 143-147 '63. (MIRA 16:8)

1. Ural'skiy politekhnicheskiy institut.
(Steel—Hardening) (Crystal lattices—Defects)

BOGACHEV, I.N.; ROZHKOVA, S.B.

Hardening austenitic steels by cold plastic deformation. Izv. vys. ucheb. zav.; chern. met. 6 no.7:162-168 '63. (MIRA 16:9)

1. Ural'skiy politekhnicheskiy institut.
(Steel--Hardening) (Deformations (Mechanics))

BOGACHEV, I.N.; MINTS, R.I.; Prinimala uchastiye PETROVA, S.N.

Effect of treatment in fused media on the plasticity of transformer steel. Izv. vys. ucheb. zav.; chern. met. 6 no.9:174-176 '63. (MIRA 16:11)

1. Ural'skiy politekhnicheskiy institut.

S/185/63/008/002/007/012
D234/D308

AUTHORS: Mel'nikova, V. I. and Bogachev, I. N.

TITLE: Kinetics of the ordering in the Ni_3Mn alloy

PERIODICAL: Ukrayins'kyy fizychnyy zhurnal, v. 8, no. 2, 1963, 219-226

TEXT: The authors investigated the dependences of electrical resistance, saturation magnetization, coercive force, volume and thermal emf on the duration of isothermal treatment at 350, 400, 425, 450, 475 and 500°C. The velocity of transition into ordered state was found to be maximal at 450 and 475°C. Conclusions: there are two stages of variation of resistance, magnetization and coercive force, which the authors attribute to properties of structural transformation during ordering. Plastic deformation does not always affect the variation of electrical resistance in the same manner at different stages of ordering, which is probably due to different structural states of the alloy at these stages. Plastic deformation

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affects substantially the variation of physical properties in subsequent isothermal treatment below the phase transition temperature T_c, but general regularities of the kinetics of ordering are as in the hardened alloy. There are 6 figures.

ASSOCIATION: Ural'skiy politekhnicheskiy institut (Ural Polytechnic Institute), Sverdlovsk

BOGACHEV, I.N., doktor tekhn.nauk, prof.; MINTS, R.I., kand.tekhn.nauk;
VEKSLER, Yu.G.

Cavitational resistance of austenitic ferrite steel.
Energomashinostroenie 9 no.9:29-31 S '63. (MIRA 16:10)

L 10399-63 EWP(q)/EWT(m)/BDS--AFFTC/ASD--JD

ACCESSION NR: AP3001694

S/0126/63/015/005/0678/0684

59
57

AUTHOR: Bogachev, I. N.; Malinov, L. S.

TITLE: Effect of chromium and nickel on phase transformations and strengthening of manganese steel during plastic deformation

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 5, 1963, 678-684

TOPIC TAGS: high-manganese G20 steel, cold deformation, phase transformations, strain hardening, effect of Cr, effect of Ni, prestraining, Epsilon phase, Alpha phase

ABSTRACT: Specimens of G20 high-manganese steel (compositions shown in Table 1 of Enclosure) annealed at 1050C were used to study the effect of Cr and Ni on phase transformation and strain hardening. It was found that both Cr and Ni stabilized austenite and delayed Epsilon-phase formation. Plastic deformation increased the amount of the Epsilon-phase in unalloyed G20 from 60 to 88%, in alloy G20Kh2 from 45 to 76%, and in alloy G20Kh6 from 32 to 52%. Ni was found to be a much stronger austenite stabilizer; the initial amount of Epsilon-phase in alloy G20N2 was only 16%; plastic deformation increased it to 32%. In all alloys,

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L 10399-63
ACCESSION NR: AP3001694

the ...est rate of Epsilon-phase formation was observed during stretching of up to ... In alloy G20Kh12, which in the annealing condition was fully austenitic, an intensive formation of the Epsilon-phase occurred during stretching of up to 12%. In alloys G20N6 and G20N10 cold working produced a negligible amount of Epsilon-phase, not exceeding 2--3% at maximum deformation. The Alpha-phase formation rate was insignificant, not exceeding 5% for all alloys. No Alpha-phase formation was observed in alloys G20N6 and G20N10. Stretching reduced the dilatometric effects of the Epsilon-to-Gamma and Gamma-to-Epsilon transformations, shifted the temperature range of the Epsilon-to-Gamma transformation toward lower temperatures, and lowered the temperature of the beginning of the Gamma-to-Epsilon transformation. Both Cr and Ni lowered phase transformation temperatures. Cr and especially Ni decreased the strain-hardening exponent at strains of 0.2--2.0%. At strains of 2--18%, Ni alone slightly decreased the exponent. The effect of Cr and Ni on the mechanical properties of the alloys is presented in Table 2 of Enclosure. The yield strength of the alloys, which is generally low, can be increased by prestraining by 4--14%, depending on the alloy composition. Orig. art. has: 5 figures and 3 tables.

Ural Polytechnical Inst.

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L 18103-63 EWP(q)/EWT(m)/BDS AFFTC/ASD Pad JD/HW
ACCESSION NR: AP3002844 S/0126/63/015/006/0860/0866 67 64

AUTHORS: Chumakova, L. D.; Bogachev, I. N.; Shklyar, R. Sh; Mints, R. I.

TITLE: Phasal and structural changes in the surface layer of austenite alloys at the initial stage of the cavitation effect

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 6, 1963, 860-866

TOPIC TAGS: cavitation effect, austenite alloy , Ni, Mn, phasal change, structural change

ABSTRACT: Structural changes in the surface layer of austenitic Ni and Mn alloys subjected to minute impacts were studied by x-rays. It was established that the cavitation effect results in the increase of submicroscopic nonhomogeneity of intragranular structure and in a partial decomposition of austenite. Depending on their chemical composition, the manganese samples showed a partial decomposition of austenite and the formation of ε-phase or of ε-phase and martensite. The Ni samples showed decomposition of a small amount of austenite and the formation of martensite. The conversions $\gamma \rightleftarrows \varepsilon$ in the G30 alloy and $\gamma \rightleftarrows \varepsilon \rightarrow \alpha$

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L 18103-63

ACCESSION NR: AP3002844.

3

in the 40G14 steel harden the alloys and increase their resistance to cavitational destruction. The high resistance of the stable manganese austenite 40G30 to the impacts proves that phasal transformations are not the only factors determining the high stability of alloys with respect to the cavitation effect. Orig. art. has: 1 table, 3 graphs, and 2 photographs.

ASSOCIATION: Ural'skiy politeknicheskiy institut im. S. M. Kirova (Ural Polytechnic Institute)

SUBMITTED: 31Oct62 DATE ACQ: 23Jul63 ENCL: 00

SUB CODE: ML NO REF SOV: 005 OTHER: 001

Card 2/2

BOGACHEV, I.N.; ROZHKOVA, S.B.

Peculiarities of the effect of martensite transformation on the graphitization of nickel steel. Fiz. met. i metalloved. 16 no.2:267-272 Ag '63. (MIRA 16:8)

1. Ural'skiy politekhnicheskiy institut im. S.M. Kirova.
(Nickel steel—Metallography)
(Phase rule and equilibrium)

BOGACHEV, I.N.; YEGOLAYEV, V.F.; MALINOV, L.S.

Stabilization of $\gamma \rightarrow \varepsilon$ transformations during recurrent phase transitions. Fiz. met. i metalloved. 16 no.4:544-550 0 '63. (MIRA 16:12)

1. Ural'skiy politekhnicheskiy institut imeni S.M.Kirova.

BOGACHEV, I.N.; LITVINOV, V.S.; MINTS, R.I.

Characteristics of the plastic deformation of austenitic manganese and nickel alloys. Fiz. met. i metalloved. 16 no.4:596-602 O '63. (MIRA 16:12)

1. Ural'skiy politekhnicheskiy institut imeni S.M.Kirova.

BOGACHEV, I.N.; YEGOLAYEV, V.F.

Effect of molybdenum and tungsten on $\gamma \rightleftarrows \varepsilon$ transformations in Fe-Mn alloys. Fiz. met. i metalloved. 16 no.5:710-713 N '63. (MIRA 17:2)

1. Ural'skiy politekhnicheskiy institut im. S.M.Kirova.

BOGACHEV, I.N.; DAVYDOV, G.S.; ROZHKOVA, S.B.; SIDORENKO, R.A., kand. tekhn. nauk, retsenzent;

[Grafitization and heat treatment of white cast iron] Grafitizatsiia i termicheskaia obrabotka belogo chuguna. Moskva, Izd-vo "Mashinostroenie," 1964. 145 p. (MIRA 17:8)

L 17592-65 EWT(m)/EWA(d)/T/EWP(t)/EWP(b) IJP(c)/AEDC(a)/ASD(m)-3/ASD(f)-2/
ASD(p)-3 JD/WB/MLK
ACCESSION NR AM4046710 BOOK EXPLOITATION S/

Bogachev, I. N.; Minte, R. I.

Improving the cavitation-erosion resistance in machine parts (Povy*sheniye kavitatsionno-erozionnoy stoykosti detaley mashin), Moscow, Izd-vo "Mashinostroyeniye", 1964, 142 p. illus., biblio. 3,800 copies printed.

TOPIC TAGS: metallography, cavitation, austenitic steel, copper alloy, surface activity, chromansil steel

PURPOSE AND COVERAGE: This book is devoted to the metallography of cavitation failure of ferrous and nonferrous alloys. It considers problems related to selection of alloy compositions that are resistant to cavitation-erosion failure. On the basis of established laws, the ways of improving the cavitation-erosion resistance of metals are shown. The book is intended for technical and scientific workers -- metallurgists, heat treaters, and designers.

TABLE OF CONTENTS [abridged]:

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L 17592-65
ACCESSION NR AM4046710

SUB CODE: MM SUBMITTED: 25Feb64 NR REF SOV: 043

OTHER: 015

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L 20995-65 EWP(k)/EWT(m)/EWP(b)/T/EWA(d)/EWP(t)/ Pf-4 ASD(f)-3/ASD(m)-3/IJP(c)
JD/HW

ACCESSION NR: AP5000142 S/0149/64/000/005/0119/0122

AUTHOR: Odinokova, L. P.; Bogachev, I. N.

TITLE: Metallographic investigation of the plastic deformation of zinc under different types of loading

SOURCE: IVUZ. Tsvetnaya metallurgiya, no. 5, 1964, 119-122

TOPIC TAGS: metallography, zinc, plastic deformation, zinc crystal structure, recrystallization annealing, twinning

ABSTRACT: The plastic deformation of zinc, a metal with a hexagonal lattice, was investigated during exposure to different loading conditions. The starting material was granulated zinc, rolled to a strip and subjected to recrystallization annealing. Average grain size was 0.25 mm. Specimens cut from the strip were subjected to tensile, compressive, and impact testing. Deformation by tension and compression was accomplished at rates of 0.05, 0.8, 12.5, and 25.0 mm/min. Impact testing was done with a 6 kg weight from a height of one meter. Plastic deformation of zinc at rates of 0.05 mm/min. and lower was accompanied by the appearance of right-angled parallel lines in the grains, which were traces of the intersection of the slip plane with the specimen surface. Slip occurs along the base plane. As deformation increased, twinning occurred.

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L 20996-65
ACCESSION NR: AP5000142

Twinning was enhanced by an increase in the deformation rate from 0.05 to 0.8 mm/min. Specimens deformed by compression did not reveal any fundamental differences in the pattern of plastic deformation, but the mechanism of deformation with impact loading was different. Intense twinning occurred both at room temperature and at the temperature of liquid nitrogen. The specimens deformed at room temperature had twins in the form of segments or needles, whereas impact deformation at the temperature of liquid nitrogen produced twins in the form of rectilinear colonies with branched ends. Twinning was the main mechanism of deformation of zinc under both static and impact loading. It was found that the base plane was not the only plane along which slip occurs in zinc at room temperature. A second slip plane, evidently pyramidal, was observed under certain conditions of loading zinc. Orig. art. has: 6 figures.

ASSOCIATION: Ural'skiy politekhnicheskiy institut (Ural'sk Polytechnical Institute)

SUBMITTED: 12Dec63 ENCL: 00 SUB CODE: MM, SS

NO REF SOV: 005 OTHER: 004

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This individual will be rerun on next reel.

REEL #57

BOBROVA, V.R.

~~BOBROVNIK, D.T.~~

to

END